

THE TREATMENT OF INVETERATE TALIPES EQUINO-VARUS BY OSTEOTOMY.¹

By CHARLES T. POORE, M. D.,

OF NEW YORK.

SURGEON TO ST. MARY'S FREE HOSPITAL FOR CHILDREN.

THE management of cases of congenital equino-varus which have resisted all the usual methods of mechanical treatment—tenotomy, stretching, etc.—has received much attention from surgeons, and various operations have been proposed for its correction. The majority of infants with this deformity are and can be cured by mechanical treatment, but there is a certain number of persons who, either from the marked degree of the deformity, neglect or inefficient treatment, are unable to walk on the plantar surface of their feet, and in whom locomotion is labored and painful. Even in children it is sometimes impossible to hold the foot in a proper position without the aid of an apparatus after years of careful treatment. With the brace applied they are able to walk on the plantar surface of their feet, but, as soon as it is removed, the anterior portion of the foot reverts to its abnormal position.

The cause of this failure to relieve the deformity is not clearly understood or, if acknowledged, is not appreciated by many surgeons. The muscles, ligaments and bones have each and all been assigned as the cause of the deformity, and operative treatment has been directed to that tissue which, in the judgment of the surgeon, is the one at fault.

In order to understand the cause of this inability to hold the anterior portion of the foot in a proper position and, when an operation is called for, to judge of the best means of correcting the deformity, a consideration of the anatomy of congenital equino-varus is necessary.

¹Read before the New York Surgical Society, December 8, 1886.

Through the kindness of Dr. J. B. Bissell I have had the opportunity to examine the bones taken from a child eight months of age who exhibited this deformity.

When the foot is viewed with the anterior portion placed in its abnormal position, the deformity does not appear to be one of marked degree.

The patient had been under treatment for some months, and at the time of death the anterior segment of the foot had been brought into its normal position and held there as long as the splint was on, but on its removal, had immediately reverted to its abnormal position. The tendo Achillis had been divided.

On examining the bones, changes are found in the shape of the os calcis, astragalus and scaphoid bones. The trochlear surface of the astragalus is longer in its antero-posterior direction and is more flattened posteriorly, than in the normal bone. The body is more angular, being broader in front. If an imaginary line is drawn at right angles to one bisecting transversely the articular surface of the body, it will be found that the neck is set upon the body at an angle of 55°.

The external aspect of the neck is greatly elongated. The direction of its external border from where it springs from the body is forward and inward, and presents a straight line; the inner border is much shorter.

On account of this obliquity of the neck, the head of the bone is directed forward and inward so that it is at right angles with the longitudinal axis of the body of the bone; the head is smaller and more conical than in an astragalus taken from a normal foot. The head of the bone from the left foot presents two facets, the planes of which meet at an obtuse angle; the inner articulates with the scaphoid; the outer looks forward and is unopposed. The head of the bone from the right foot does not show any division into facets. Its general shape in front of the body is conical and has not the globular appearance of the head of the normal astragalus.

The os calcis appears to be of normal shape and size in its posterior segment. The anterior portion is curved from before backward, the convexity being directed outward, and its anterior articulating surface looks forward and inward. It also

extends farther forward than in the normal bone and is therefore elongated. The scaphoid is carried upward and inward by the head of the astragalus, and has a facet on its upper and posterior (lateral) border which articulates with the anterior portion of the malleolus. The rest of the bone seems normal. The other tarsal bones present nothing to contribute to the deformity.

The ligaments upon the inner side of the foot are greatly shortened—namely, the anterior portion of the internal lateral ligament of the ankle joint, the astragalo-scaphoid, the calcaneo-scaphoid and also the inner portion of the plantar fascia. These hold the navicular bone and the head of the astragalus in their abnormal position.

The question naturally arises, how much these bones here described differ from those of the normal infantile skeleton. Mr. Adams states that the neck of the normal infantile astragalus at term look directly forward.

In a bone taken from a child eight months of age with normal feet it is found that the neck is set upon the body of the bone at an angle of 28° . The external portion of the neck is not elongated, and the head and neck are not conical; it also presents a much larger articulating surface.

The *os calcis* is curved on its lower posterior border, the concavity looking downward and the line of its external aspect from the tubercle forward is straight or, if anything, is a little concave; certainly not curved with the convexity directed outward. The anterior articulating surface is directed forward.

In comparing these bones, the following are their points of difference:

The angle at which the neck of the astragalus is set upon its body in the bone from the deformed foot is 55° , while that of the normal bone is 28° . The external surface of the neck of the abnormal is much longer than that of the normal bone; the articulating surface of the head is much smaller in the former than in the latter.

The anterior articulating surface of the *os calcis* is directed forward and inward in the bone from the deformed foot, while

in the normal it is directly forward. Its anterior portion is curved outward in the deformed foot, but is straight in the one from the normal foot.

Mr. Adams, in his work on club-foot, describes the same changes in the astragalus and os calcis as those mentioned above, except that he does not notice the change in the direction of its anterior articulating surface nor its elongation.

He considers any deviation of the axis of the neck of the astragalus from a straight line with that of the body as pathological.

Mr. Parker and Mr. Shattock, in a paper published in the "Transactions of the London Pathological Society" for 1884, give the result of their dissection of feet affected with talipes equino-varus, and compare the astragalus and os calcis with normal infantile bones.

They state that they find that "the normal astragalus of infants differs considerably from that of the adult in the direction and extent of the articulating facet of the head and in the obliquity of the neck." As a basis of comparison they made measurements of the obliquity of the neck in twenty specimens of adult astragali taken promiscuously. The mean angle at which the neck was set in the body of the bone was $10^{\circ}65$, the maximum was 26° , while the minimum was so small that to measure it was impracticable. In the foetus, from about the fourth month to term, in eleven cases the mean angle was 38° , maximum 42° , minimum 35° . In five cases of varus the mean angle was $49^{\circ}6$, the maximum 64° , minimum 31° .

From these facts it would seem proved that the obliquity of the neck of the astragalus is a normal condition in infants at term; that in varus, as a rule, the amount of the obliquity is increased and that in the adult bone the neck is set upon the body of the bone at a mean angle of $10^{\circ}65$; that in varus the anterior portion of the os calcis is curved with its convexity looking outward, and that its anterior articulating surface is directed forward and inward. It is evident, then, that during growth the axis of the neck of the astragalus in the normal foot changes from an angle of 38° to one of $10^{\circ}65$ with that of the longitudinal axis of the body.

It is a well-known fact that at birth the feet of infants are in a position of slight varus. The age at which the neck of the astragalus assumes the adult position has not been determined, nor am I aware of any fact bearing on the point. Many recent writers on this subject attribute this deformity to the position of the feet *in utero*, and consider that the change in the shape of the neck is due to long continued inversion of the feet and that the head and neck are held in this abnormal position by shortened ligaments. The alteration in the os calcis may be attributed to traction from the displaced bones on the inner aspect of the foot. The pathological changes found in the majority of cases of congenital talipes equino-varus may be described as an exaggerated obliquity of the neck of the astragalus and curvature of the anterior portion of the os calcis, together with its elongation, and that the head of the astragalus is held in its abnormal position by short ligaments; that the scaphoid is carried upward and inward by the astragalus and held there by the abnormal condition of the ligaments; that the muscles have nothing to do with its causation, nor do they act as much of an obstacle to the restitution of the foot. Exception should however, be made to muscles entering into the formation of the tendo Achillis.

It should be stated that in one dissection, reported by Mr. Parker and Mr. Shattock, of congenital equino-varus the obliquity of the neck was only 31° , being less than in the normal bone.

If the foregoing facts have been correctly interpreted, the indications for the treatment of congenital equino-varus seem simple. The object of mechanical treatment must be to stretch the ligaments upon the inner side of the foot, which hold the scaphoid and head of the astragalus in their abnormal position, so that the obliquity of the astragalus may undergo the diminution incident to normal growth or, in other words, assume the form of the adult astragalus. There is still another element, in some cases at least, which prevents a perfect restitution and that is the elongation of the os calcis. Even should the deformity of the astragalus be entirely overcome, the outer border of the foot would be longer than its inner and thus con-

tinually tend to force its unsupported anterior segment inward.

In cases which have resisted all known methods of mechanical treatment the question arises, What operation is the best to restore the foot to a useful position? All operative procedures may be considered under two heads: section of ligaments and operations upon the bones. In 1881 Dr. A. M. Phelps divided all resisting bands and ligaments by cutting down through a large wound on the inner side of the foot until he was able to bring the parts into their normal position, and then allowing the wound to cicatrize while the foot was held in a straight position; fourteen weeks after the operation a club-foot shoe was applied. In another case the same operation was performed, leaving an open wound one inch and a half wide and extending down to the bone; there is no later report of these cases so far as I am aware.

Mr. R. W. Parker published a paper in the *Brit. Med. Jour.*, July 3, 1886, in which he advocates subcutaneous division of the ligaments on the inner side of the foot and then correcting the deformity. He states, however, that there are some cases in which this method will fail, and tarsectomy must be performed.

Mr. Little advocated the removal of the cuboid, and Solly excised that bone in 1854, but it did not prove a success; it has been performed in this country by Stephen Smith, but it, too, was a failure, and Syme's amputation was subsequently performed. The operation seems to have been abandoned until 1874, when Richard Davy reintroduced and performed it in six cases; he reports them successful. In 1881 Mr. Laud removed the astragalus by gouging, but it does not appear that his patient ever walked without support. Other operators have removed the bone, but with varying success, the ankle joints being left stiff, and in many cases an apparatus had to be worn.

Otto Weber in 1886 removed a wedge-shaped piece of bone, including a portion of the cuboid and os calcis; and Davies Colley performed a wedge-shaped excision of the tarsus in 1875. Since then Mr. Richard Davy has been a most ardent advocate of the operation. There is no question that a cunei-

form osteotomy for persistent club-foot is an excellent operation, the only question being as to where the wedge should be taken from; all operators have made the cuboid at least form the base of the wedge. Mr. Davy says that it almost invariably includes portions of the os calcis, astragalus, and scaphoid bones. In one case he removed a portion of the os calcis, the head of the astragalus, and the whole of the scaphoid. Some surgeons have gone farther forward, like Barwell, who removed portions of the anterior row of tarsal bones. By these operations the foot is much shortened, and many of the tarsal joints are destroyed; the patient walks, it is true, on the plantar surface of what remains of his foot, but with ankylosis of all the joints but the ankle and those in front of the first row of tarsal bones.

From a study of the bones from feet affected with talipes equino-varus, it is evident that the real trouble lies not in *front* of, but *behind* the medio-tarsal joint; and that all operations on the bones in front of this point are anatomically and mechanically wrong.

The only operation that of late years has commended itself to surgeons is a cuneiform osteotomy or resection of the tarsal bones in front of Chopart's joint; all others have failed to accomplish the end for which they were performed, and have been abandoned.

Tenotomy of the ligaments commends itself as one from which good results may be expected in infants, because it attacks the structure which is the chief obstacle to the normal development of the astragalus, but it has no influence on the curvature of the os calcis, and this, it would seem, is the cause of imperfect restitution in otherwise promising cases.

In looking at a dissection of a foot affected with the deformity under consideration, the following points suggested themselves:

1. That the inability to correct the deformity was due to changes taking place in the astragalus and os calcis.
2. That, in order to bring the anterior portion of the foot into its normal position, the curvature in the os calcis must be removed and the neck of the astragalus shortened, so as to

allow its head to point in the normal direction and thus carry with it the scaphoid and other tarsal bones.

To accomplish this, the following operation was performed: An incision was made from a point one inch and a half in front of the *tendo Achillis* on the outer aspect of the foot forward to the middle of the cuboid bone, and down to the tendons of the *peroneus longus* and *brevis*: These should be raised or pushed out of the way. Another incision, beginning from the middle of the first and corresponding to the neck of the astragalus, was made directly upward; the tissues were then raised from the bones and the periosteum incised over that part of the *os calcis* from which it was desired to remove the wedge. With a chisel a V-shaped piece of bone was taken away, base outward, and its apex extending to its inner border; a wedge was then removed from the neck of the astragalus of such a shape as to allow the anterior portion of the foot to be brought outward and upward. The periosteum was united with catgut and the skin with several wire sutures, because the latter held longer and gave better support. An aperture was left posteriorly for the insertion of a drainage-tube; a plaster-of-Paris bandage was applied, extending from the toes to above the knee, and the foot was placed in a corrected position; the wound was dressed with iodoform gauze.

The size of the V-shaped interval left after the removal of the wedge of bone was sufficient to allow the anterior portion of the foot to be placed in a proper position without any tension on the tissues on its inner aspect. I think that a subcutaneous division of the ligaments on the inner border of the foot, when they are tense, would facilitate the correction.

The dressings should be as light as possible, not bulky. Otherwise it will be found difficult to apply the plaster-of-Paris bandage firmly; a little over-correction does no harm.

The advantages maintained for this operation over that of removing a wedge from in front of the medio-tarsal joint are:

1. It is anatomically and mechanically correct.
2. A smaller amount of bone has to be removed, because the operation is performed nearer the apex of the triangle.
3. No joint is opened, and, consequently, the foot is left in a more normal condition.

4. It does not practically shorten the foot in front of the ankle joint.

The class of cases suitable for this operation are:

1. Those of patients who have reached the age of 5 or 6 years with the deformity unrelieved, who have walked on their feet, and in whom the parts are rigid and the deformity marked.

2. Those cases in which, although the anterior portion of the foot can be brought into position, yet require an apparatus to retain the foot in its normal position after years of careful treatment.

3. Those cases in which the obstacle to restitution is due to elongation of the *os calcis*; perhaps in these patients the removal of a small wedge from that bone would accomplish the result.

CASE I—W. S., ten years of age, was admitted into St. Luke's Hospital, in September, 1885, with congenital talipes equino-varus of the right foot. The deformity had never been treated; walks on the outer side of the foot. The parts were rigid, and with the hand no change could be made in the position of the anterior portion of the foot; there was no motion at the ankle joint.

In October the *tendo Achillis* was divided, and Bradford's instrument for forcibly rectifying club-foot used; but no impression could be made on the position of the foot. In November another attempt was made with the same instrument, but with no better success. On January 14, 1886, I performed the operation advocated in this paper, and brought the anterior segment of the foot into a straight line. There was considerable oozing of blood for a day, so that the dressings had to be changed, and, in a week there was some slight suppuration. During the treatment he had an attack of scarlet fever. The wound all closed within a month, but he was not allowed to use his foot for eight weeks. At the date of his discharge from the hospital he was able to walk well, with his foot flat on the floor. There was but little motion at the ankle-joint. The line of the inner and outer borders of the foot was perfect, with not the slightest tendency to inversion.

CASE II.—A. S., eight years of age, was admitted into the hospital in November, 1885, with double congenital talipes equino-varus. His tendons had been cut, and he had been under mechanical treatment for years, but with no benefit. The *os calcis* was in its normal posi-

tion, but the anterior portion of the foot was turned at a right angle to the *os calcis*. Three attempts had been made to correct the deformity with Bradford's instrument, but without making any impression on the position of the foot.

December 25, 1885.—A wedge was removed from the *os calcis* and neck of the *astragalus* in the same manner as mentioned above; the wound was all closed in a few weeks, the temperature not reaching beyond 100°.

February 6, 1886.—The same operation was performed upon the right foot; the date of his discharge the patient was able to walk with the sole of the foot flat on the floor. He had always had some paresis of the extremities, so that he had never had good use of his limbs. He walked, at the time of his discharge, quite well; but there was a tendency of the whole foot to point inward. I do not think the correction was as perfect as in the first case.

CASE III.—M. J. C., aet. fourteen, has been under treatment at the hospital at times for several years. She has had a congenital *talipes equino-varus* of left foot, which has been corrected so that the anterior portion of the foot can be brought into its normal position with the hand, but immediately on removal of the support it turns somewhat inward. She has worn a brace for several years; with it she gets along pretty well, but without it the foot is almost useless.

February 28, 1886.—A V-shaped piece of boue was removed from the *os calcis* and the neck of the *astragalus*, and the anterior portion of the foot placed in a straight position. A plaster-of-Paris splint and dressings of gauze and iodoform, as in the other cases, were used. Owing to illness, I did not see the patient again for a week; she then had a high fever, the foot was swollen, and the wound looked blue and sloughy; the splint was removed and the wound dressed, the fever continued, and she died on the twelfth day, of *septicæmia*.